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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 278 457 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88101808.3

(51) Int. Cl.⁴: H05K 13/04

(22) Date of filing: 08.02.88

(33) Priority: 09.02.87 JP 27607/87
28.08.87 JP 215768/87

(43) Date of publication of application:
17.08.88 Bulletin 88/33

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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(54) Method of coating adhesive for mounting parts onto a printed substrate and apparatus therefor.

(57) The present invention discloses a method and apparatus for coating adhesive for mounting parts onto a printed substrate in which an adhesive coating nozzle is arranged in correspondence to the printed substrate placed on an X-Y table controlled to be moved in an X-Y direction, and said coating nozzle is operated to coat the adhesive within an adhesive storage tank in position on each of the printed substrates, at which a waste coating is carried out for said coating nozzle before the latter performs the coating operation with respect to the printed substrate, whereby even if the adhesive trickles from the end of the nozzle to bring forth the liquid-drip state, the adhesive in the liquid-drip state is eliminated by the waste coating of the coating nozzle to prevent the adhesive in the amount more than as needed from being coated on the printed substrate, thus always maintaining a stable amount of coating thereby positively preventing occurence of irregularities in quantity.

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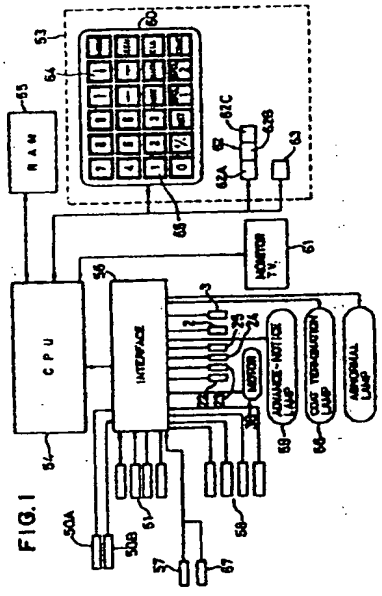


FIG. 1

METHOD OF COATING ADHESIVE FOR MOUNTING PARTS ONTO A PRINTED SUBSTRATE AND APPARATUS THEREFOR

2. BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to a method of coating adhesive for mounting parts onto a printed substrate incorporated in an automatic mounting device for electronic parts and apparatus therefor, and more specifically, to a method of coating adhesive for mounting parts and apparatus therefor which can be applied to temporary mounting before final mouning by soldering in which chipped electronic parts (hereinafter referred to as chip part), for example, such as resistors, capacitors or transistors are positioned and mounted on a printed substrate.

(2) Prior Art

In the conventional automatic mounting device for electronic parts of this kind, a plurality of multiphase printed substrates are placed on an X-Y table controlled to be moved in an X-Y direction at fixed intervals, a plurality of adhesive coating nozzles corresponding to these printed substrates are arranged, said coating nozzles being selectively synchronized, adhesive within an adhesive storing tank is coated in position on each of the printed substrates before a chip part to be positioned and supplied by a part supplying device is mounted, and a chip part to be positioned and mounted on each of the printed substrates from the part supplying device is temporarily mounted.

In the existing circumstances, however, for the conventional coating devices for adhesive for mounting parts on the printed substrate, particularly for coating nozzles, large-dimameter nozzles in which the amount of coating adhesive per coating operation is large and small-diameter nozzles in which the amount of coating adhesive is small are selectively used.

Therefore, in the above-described conventional coating apparatus, there poses no problem for the case of the coating nozzle which intermittently carry out the coating operation of adhesive to the printed substrate; but in the case of the other coating nozzles which are left unused for a long period of time, the adhesive within the storage tank tricles from the tip of the nozzle, which is a so-called "liquid-drip", and if in that state, coating operation of adhesive to the printed substrate is carried out, the adhesive in the amount more than as needed becomes coated on the printed substrate, which is prone to occurrence of unevenness in quality.

Also, a conventional coating nozzle has been proposed as disclosed in Japanese Patent Publication No. 61-56,638 Specification published in Japan, in which a projection is formed on a coating head, adhesive being supplied in advance from a storage tank is held on the end of the projection, and when the coating head is moved onto the printed substrate to carry out the coating operation, the adhesive held on the end of the projection is transferred between connection lands of the chip part on the printed substrate.

However, in such a coating nozzle as described above, both ends and a part of the side on the back side of the chip part may be held by adhesive but the central portion on the back side thereof cannot be held by adhesive because the adhesive is not coated thereon, whereby temporary mounting of the chip part not only becomes unstable but the adhesives are coated on the printed substrate in a spaced apart relation, and therefore if the coating amounts of adhesives are different from each other, mounting becomes unbalanced.

3. SUMMARY OF THE INVENTION

The present invention overcomes an inconvenience encountered in coating means of adhesive for mounting parts onto a printed substrate incorporated in the above-described automatic mounting device for electronic parts. It is an object of the present invention to provide an arrangement wherein an adhesive coating nozzle is arranged in correspon dence to the printed substrate placed on an X-Y table controlled to be moved in an X-Y direction, and said coating nozzle is operated to coat the adhesive within an adhesive storage tank in position on each of the printed substrates, at which a waste coating is carried out for said coating nozzle before the latter perform the coating operation with respect to the printed substrate, whereby even if the adhesive trickles from the end of the nozzle to bring forth the liquid-drip state, the adhesive in the liquid-drip state is eliminated by the waste coating of the coating nozzle to prevent the adhesive in the amount more than as needed from being coated on the printed substrate, thus always maintaining a stable amount of coating thereby positively preventing occurence of irregularities in quantity.

It is a further object of the present invention to

provide an arrangement wherein a plurality of adhesive supply channels are provided in the coating nozzles, and these supply channels are communicated with each other at the head end through communication grooves, whereby adhesiv can be coated in the shape of approximately 8-letter on the printed substrate to adhesively hold both ends including the central portion on the back side of the chip part and a part of the side and the temporary mounting of the chip part can be maintained well balanced and in a stable state.

4. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a control block diagram showing one embodiment of a method of coating adhesive for mounting parts on a printed substrate according to the present invention;

FIG. 2 is a perspective view showing a coating mechanism for adhesives;

FIG. 3 is a plan view of the coating mechanism for adhesives;

FIGS. 4 and 5 are explanatory views showing the operating state of a cam lever;

FIG. 6 is an explanatory view showing NC program for deciding coating positions or the like;

FIGS. 7 through 9 are explanatory views showing a picture plane of a monitor TV;

FIG. 10 is a flow chart showing the control state of the coating operation and leaving operation of the coating nozzles;

FIG. 11 is an explanatory view showing the state wherein adhesive is applied to a multiphase printed substrate;

FIG. 12 is a flow chart showing a control state of automatic stopping operation by cutting off the residual amount of adhesives;

FIG. 13 is a flow chart showing a control state of another embodiment according to the present invention;

FIG. 14 is an explanatory view of a memory region for the leaving operation of the coating nozzles;

FIG. 15 is an explanatory view showing another embodiment of adhesive coating operation;

FIG. 16 is a side view of a coating nozzle;

FIG. 17 is a longitudinal sectional side view of a small-diameter nozzle;

FIG. 18 is a bottom view of a small-diameter nozzle;

FIG. 19 is an explanatory view showing the coating form of adhesive on the printed substrate;

FIG. 20 is an explanatory view showing a temporary mounting state in which an electronic part is adhesively held on the printed substrate;

FIG. 21 is a bottom view of a large-diameter nozzle; and

FIG. 22 is a longitudinal sectional side view of a large-diameter nozzle.

5. DETAILED DESCRIPTION OF THE INVENTION

Detailed modes of the method of coating adhesive for mounting parts on a printed substrate and apparatus therefor according to the present invention will be described in detail hereinafter with reference to embodiments shown in FIGS. 1 through 22.

In the drawings, reference numeral 1 designates an XY table which can be moved by an X-direction drive motor 2 and a Y-direction drive motor 3 in X and Y directions, that is, in left, right, longitudinal and lateral directions, and on the table 1 are placed two multiphase printed substrates 4 and 5 at fixed intervals. Numerals 6, 7, 8 and 9 designate first, second, third and fourth coating nozzles, respectively, positioned upwardly of the XY table 1, the first and third nozzles 6 and 8 each being a small-diameter nozzle, the second and fourth nozzles each being a large-diameter nozzle. Numerals 10, 11, 12 and 13 designate tanks filled with adhesive as a coating agent, these tanks being supported by first, second, third and fourth cam levers 22, 23, 24 and 25 through roller receivers 14, 15, 16 and 17 and rollers 18, 19, 20 and 21. Numerals 26 and 27 designate fulcrum shafts provided on the other ends of the cam levers 22, 23, 24 and 25, and numerals 28 and 29 designate cams, respectively, whose diameter of an arc varies every circle, for example. One cam 28 holds first and second cam levers 22 and 23 through cam followers 30 and 31 whereas the other cam 29 holds the third and fourth cam levers 24 and 25 through cam followers 32 and 33. Stop levers 34, 35, 36 and 37 may be arranged in the intermediate position of the contact portion between the nozzle supporting portions of the cam levers 22, 23, 24 and 25 and the cams to individually and selectively hole the cam levers 22, 23, 24 and 25, respectively. Numeral 38 designates a motor which serves as a drive source for the cams 28 and 29, which motor imparts a turning force to a drive shaft 41 through a clutch brake unit 39 and a reduction gear 40.

Upon rotation of the motor 38, the cams 28 and 29 rotate simultaneously, but in the case where all of solenoids 42, 43, 44 and 45 are not excited, all the stop levers 34, 35, 36 and 37 hold the cam levers 22, 23, 24 and 25 by the bias forces of springs 46, 47, 48 and 49. Where the first nozzle 6 and the third nozzle 8 are selected, the solenoids 42 and 44 are excited as shown in FIG. 5 so that the holding of the first and third cam levers 22 and 24 by the stopper levers 34 and 36 is released

against the springs 46 and 48, and the nozzles 6 and 8 are moved closer toward the printed substrates 4 and 5 at timing in which the small-diameter portions of the cams 28 and 29 are positioned at the cam followers 30 and 32 to supply adhesive. The changing of positions of the printed substrates 4 and 5 is carried out by moving the XY table horizontally when the nozzles 6, 7, 8 and 9 are raised upwardly by the large-diameter portions of the cams 28 and 29. At that time, by increasing pressure within the tanks 10, 11, 12 and 13, a supply of adhesive to the tips of the nozzles 6, 7, 8 and 9 and switching of the stopper levers 34, 35, 36 and 37 by the solenoids 42, 43, 44 and 45 may be carried out.

The printed substrates 4 and 5 have substrate portions 4A, 4B, 4C; 5A, 5B, 5C, which can be divided for each of the substrate portions, each substrate portion being coated with adhesive in the same pattern between connection lands so that chip parts may be placed and mounted thereon. Numerals 50A and 50B designate defective mark detection sensors, which detects defective marks M marked on the substrate portions 4A, 4B, 4C; 5A, 5B, 5C.

Numeral 51 designates an advance-notice sensor comprising a pair of permeation-type photoelectric switches, which detect that the residual amount of the adhesives in the tanks 10, 11, 12 and 13 reached a predetermined level. The advance-notice sensor 51 may be of a reflection-type proximity sensor, and a ring body made of stainless steel may be provided on the outer peripheral portion of a float 52 disposed within the tank for detection.

Numeral 53 designates an operating section which produces various data by operation of keys. The central processing unit, CPU 54, is provided to carry out predetermined controls in connection with setting of various data in response to the keys and controls in connection with adhesive coating work in accordance with various information. Random Access Memory, RAM 55, is provided to store set information by said operating section 53. Numeral 56 designates an interface, which is connected to the defective mark detection sensors 50A, 50B, a group of advance-notice sensors 51, a step counter 57, a group of timers 58, a motor 38, and an advance-notice lamp 59 and the like. The aforesaid operating section 53 comprises a keyboard 60 for setting various data, a picture plane selection key 62 for a monitor TV 61, and a start key 63 for initiating the adhesive coating operation.

Next, the operation for setting frequency of coatings so that after the advance notice of run-out of the residual amount of adhesive, the adhesive coating operation may be carried out through fixed frequency, will be described.

First, when selection key 62A is depressed, a picture plane as in FIG. 8 showing the data set mode appears. Then, a cursor not shown is moved, by using a cursor indication key 64 on the keyboard 60, to a "0" position indicative of function "NONE" of "EMPTY STOP FUNCTION" (automatic stop function after advance notice of run-out of the residual amount), and numeric key 65 of "1" is depressed to set FUNCTION "PRESENT". The thus set data is controlled so as to be written into a predetermined region of RAM 55 by CPU 54. Subsequently, in order that frequency of coatings of voluntary nozzles 6, 7, 8 and 9 may be set by said voluntary indication key 64, that nozzle is assigned and thereafter the frequency can be assigned by the voluntary numeric key 65. According to FIG. 8, each of the nozzles have been assigned so that the coating operation (1,234 times) may be carried out.

The aforesaid advance-notice lamp 59 is controlled so that when the advance-notice sensor 51 detects that the residual amount of the adhesive within the tanks 10, 11, 12 and 13 has reduced to a predetermined level, the lamp is turned on by CPU 54 through the interface 56. Numeral 65 designates a coating-termination lamp which is turned on when the coating through the preset frequency has been made.

While in the present embodiment, it is designed so that after the advance-sensor 51 has detected that the residual amount of the adhesive in the tanks 10, 11, 12 and 13 has reduced to a predetermined level, the coatings through voluntary frequency can be made, it is noted that operating time of the coating operation may be voluntarily set. In this case, unit of numerals set by the numeric key 65 is seconds.

The CPU 54 controls so that from the time when it receives an advance-notice signal from the advance-notice sensor 51 through the interface 56, it deducts one by one from the set frequency every coating operation, stores the content obtained after the deduction into a predetermined area of the RAM 55 and displays the content obtained after the deduction, in the picture plane as shown in FIG. 8 by the operation of the selection key 62B, on the monitor TV 61. When the content obtained after the deduction is "0", that is, when the coating operation through the set frequency is carried out, the motor 38 is deenergized and the coating-termination lamp 66 is turned on.

Next, the timers 58 will be described which are provided corresponding to the coating nozzles 6, 7, 8 and 9 to count non-use time of the nozzles. The timer time of each of the timers 58 can be individually and voluntarily set. Therefore, the setting method thereof will be described. First, the picture plane as shown in FIG. 7 is displayed on the monitor TV 61 by depression of the picture-plane

selection key 62C of the operating section 53. Then, the cursor indication key 64 on the keyboard 60 is used, and the timer time of each timer 58 can be s t in the range of 0 to 999 seconds by the numeric key 65.

The timer time is set as just mentioned. This is because of the fact that when the non-use time is long, the adhesive trickles from each of the coating nozzles 6, 7, 8 and 9, and therefore, when the timer time has passed, marginal portions (4D and 5D) other than places at which electronic parts are placed are left to render the nozzle in the good conditions, after which the intended adhesive coating may be effected. The method of setting the leaving data will be described. FIG. 8 shows the NC program for deciding the slection of the coating position, angles of the coating nozzles, and nozzles.

First, control command "P" shows the presence and absence of repetitive patterns. Steps M1 to M100 with "P" are data indicative of selection of the coating position of the first pattern, angles of the coating nozzles, and nozzles. Steps M101 to M103 to next command "E" are offset value of the pattern position with respect to the first pattern, and M101 to M103 indicate that there are three phases. That is, each of the multiphase substrates 4 and 5 each have three substrate portions 4A, 4B and 4C; 5A, 5B and 5C, respectively. Accordingly, the coating position of the first pattern has the coordinates, (x1 + 0, yl + 0), (x2 + 0, y2 + 0) (x3 + 0, y3 + 0) ..., (x100 + 0, y100 + 0); that of the second pattern, (x1 + x1, y1 + 0), (x2 + x1, y2 + 0), (x3 + x1, y3 + 0) ..., (x100 + x1, y100 + 0); and that of the third pattern, (x1 + x2, y1 + 0), (x2 + x2, y2 + 0), (x3 + x2, y3 + 0) ..., (x100 + x2, y100 + 0). The "E" command indicates the termination of the program for deciding the coating position in normal coating operation and angles of the nozzles, and "F" command indicates the termination of the leaving data, which means that the leaving is effected at eight places at most. However, normally, each of the nozzles carry out it twice with respect to each of the substrate portions. The coordinate to be left with respect to the substrate portions 4A and 5A are (x3 + 0, y4 + 0), (x4 + 0, y5 + 0), (x5 + 0, y6 + 0), (x6 + 0, y7 + 0); that of 4B and 5B are (x3 + x1, y4 + 0), (x4 + x1, y5 + 0), (x5 + x1, y6 + 0), (x6 + x1, y7 + 0); and that of 4C and 5C are (x3 + x2, y4 + 0), (x4 + x2, y5 + 0), (x5 + x2, y6 + 0), (x6 + x2, y7 + 0). If the content of the nozzle selection data is "0", it means the small-diameter coating nozzles 6 and 8, and if the content is "1", it means the large-diameter coating nozzles 7 and 9.

When the leaving operation is carried out on the same leaving place of the substrates 4 and 5, the condition of the coating nozzles cannot be well maintained. In view of this, a leaving step counter 57 is stepped "1" by "1" every leaving for the leaving, after which the mode is shifted to the normal coating operation. However, when th timer 58 is timed up wher said coating operation is discontinued, the leaving is again carried out. If at that time, the content of the counter 57 is not "0", the step is shifted to Step M108 to effect four times of leaving in other places which are not the same leaving space.

Numeral 67 designates a leaving frequency counter, which counts the frequency of leaving and is cleared when it counts four times.

With the above-described structure, the operation will be described hereinafter. First, when the start key 63 of the operating section 53 is depressed, CPU 54 carries out a predetermined operation in accordance with the program in connection with the adhesive coating operation. First, because of the provision of the defective mark detection function, the multiphase printed substrates 4 and 5 positioned on the XY table 1 are moved on the XY table 1 by the defective mark detection sensors 50A and 50B to detect the presence or absence of the defective mark M, and CPU 54 writes the detected content into a predetermined region of RAM 55. Then, first, the content detected by the defective mark detection sensors 50A and 50B of the leftmost substrate portions 4A and 5A of the substrates 4 and 5, respectively, is read by CPU 54 through RAM 55. If the defective mark M is marked on the substrate portion 5A, it is so controlled that even if the cams 28 and 29 are rotated by the motor 38, the solenoids 44 and 45 are not excited. Accordingly, the third and fourth cam levers 24 and 25 are not moved down bythe stopper levers 36 and 37, and therefore the coating operation will not be carried out by the coating nozzles 12 and 13.

On the other hand, either solenoids 42 and 43 is excited on the substrate portion 4A not marked with the defective mark M whereby either stopper levers 34 and 35 may be rotated, and either cam levers 22 and 23 moves down. Accordingly, the adhesive is coated onthe substrate portion 4A by either coating nozzles 6 and 7 acccording to the content of the nozzle selection data. At that time, the adhesive is coated on the substrate portion 4A at 100 places, and the coordinates of the coating position are (x1 + 0, y1 + 0), (x2 + 0, y2 + 0), (x3 + 0, y3 + 0) ..., (x100 + 0, y100 + 0).

Each of the timers 58 of course starts counting when the power source is closed but repeats its counting and setting till the final step of coating on the substrate portion 4A while resetting the timers 58 corresponding to the nozzles 6 and 7 after the coating operation has been carried out. At the final step, the leaving step counter 57 is cleared, and the counting and setting by the timers 58 cor-

responding to the nozzles 6 and 7 are repeated till the coating operation of the multiphase printed substrate 4 terminates.

On the other hand, sinc the defective mark M is not marked on the substrate plate 5A, the coating nozzles 8 and 9 will not effect the coating operation. Therefore, the timers 58 corresponding to these nozzles 8 and 9 are timed up. Accordingly, CPU 54 controls the motor 38, the solenoids 44 and 45, the X-direction drive motor 2 of the XY table and the Y-direction drive motor 3 so as not to be left by the marginal portion 5D of the substrate portion 5B before the normal coating operation is effected on the succeeding substrate portions 4B and 5B. If first, the leaving frequency counter 67 is cleared and the content of the leaving step counter 57 is "0", Step 104 is selected, and the solenoid 44 is excited because the content of the nozzle selection data is "0" and the coating nozzle 8 moves down and the XY table moves and then the adhesive is left on the coordinate (x3 + 0, y4 + 0). "1" is added to the contents of the leaving frequency counter 67 and leaving step counter 57. Next, the content of the leaving frequency counter 67 is not "4" and the step is not the leaving-termination step, and therefore, next Step M105 is selected and the nozzle selection date is "1", and therefore the solenoid 45 is excited and the adhesive is left on the coordinate (x4 + 0, y5 + 0) by the nozzle 9. In this manner, the leaving by the alternate nozzles 8 and 9 are successively carried out four time in total, and then the leaving operation is terminated and the leaving frequency counter 67 is cleared.

Then, the step is shifted to the normal coating step to start the coating operation for the substrate portions 4B and 5B. It is of course that in accordance with the Steps M1 to M100, the nozzles 6 and 8, and 7 and 9 are synchronized to effect the coating operation for both the substrate portions 4B and 5B on the basis of the content of the nozzle selection data.

The case will be described in which the lock type start key 63 is depressed by the user, halfway of the coating operation for the substrate portions 4B and 5B, to stop the coating operation. At this time, each of the timers 58 is timed up, and if the start key 63 is again depressed, the coating operation starts but the leaving is again carried out therebefore. This need be carried out avoiding places already left, which will be described hereinafter.

First, the leaving frequency counter 67 is cleared. Since the leaving step counter 57 has its content "4" as previously mentioned, Step M108, which is obtained by adding 4 to the step number 104, is selected to effect the leaving operation. Thus, since the nozzle selection data is "0", the solenoids 42 and 44 are excited to rotate the stopper levers 34 and 36 to mov down the cam levers 22 and 24, and the leaving is carried out by the coating nozzles 6 and 8. At this time, the coordinate to be left is (x7 + x1, y8 + 0), and the X-direction drive motor 2 and th Y-direction drive motor 3 are controlled to move the XY table 1. And, "1" is added to the contents of the leaving frequency counter 67 and leaving step counter 57, and then, the content of the counter 67 is "1" and the content of the counter 57 is "5". Since the content of the leaving frequency counter 67 is not "4", the next leaving step is selected and the step proceeds to Step M109. Since the nozzle selection data of Step M109 is "1", the solenoids 23 and 25 are excited and the leaving is carried out by the coating nozzles 7 and 9, the coordinate of which is (x8 + x1, y9 + 0). In this manner, the step comes to Step M111, and the content of the leaving frequency counter 67 is then "4", tereminating the leaving operation. The leaving frequency counter 67 is cleared, and the coating operation starts from the step next to the step in which the coating operation for the substrate portions 4B and 5B stops.

When the coating operation for the substrate portions 4B and 5B terminates as described above, the leaving step counter 57 is cleared, and the step proceeds to the next coating operation for the substrate portions 4C and 5C. Since the defective mark M is marked on this substrate portion 5C, the coating operation is not applied to the substrate portion 5C but to the substrate portion 4C alone, as previously described.

Then, the solenoids 42 and 43 are excited whereby the coating operation by the coating nozzles 6 and 7 is carried out with respect to the substrate portion 4C as previously mentioned. When the coating operation for the multiphase substrates 4 and 5 is terminated, said substrates 4 and 5 on the XY table 1 are fed downstream, the substrate (not shown) next to the upstream is placed on the XY table 1 to effect the coating operation in a manner similar to the above. At this time, the next multiphase substrate arrives to receive the coating operation. Here, the leaving as mentioned above is carried out before the coating operation is carried out with respect to the right-hand substrate.

In the case where the frequency of use of the small-diameter coating nozzles 6 and 8 is considerably different from that of the large-diameter coating nozzles 7 and 9, the timers 58 corresponding to the coating nozzles which are less in frequency of use are timed up even during the coating operation but also at this time the leaving operation is carried out. It is desired at this time that the leaving is carried out only for the coating nozzle correspond-

ing to the timed up timer 58.

The coating operation is carried out as described above. In the following, the adhesive-residual run-out automatic stop function will be described. For example, when the advance-notice sensor 51 detects that the residual of the adhesive within the tank 10 shown in FIG. 2 reduced to a predetermined level, the CPU 54 which has received an advance-notice signal through the interface 56 controls so as to light the advance-notice lamp 59 if the former confirmed the presence of the residual run-out automatic function. At this time, the CPU 54 informs the user of the fact that said residual is in the predetermined amount by the advance-notice lamp 59 and the monitor TV 61 on the monitor TV 61 as indicated by "*" on the line corresponding to the coating nozzle 8, as shown in FIG. 8.

Since the residual still remains, the coating can be carried out through the set frequency by the numeric key 65 on the keyboard 60. At this time, each one (1) is deducted every coating operation from the 1,234 times which are set frequency of the coating nozzle 6 as shown in FIG 8. The content after such deduction is stored in the RAM 55 and is displayed on the monitor TV61. When the coating operation is carried out through the set frequency after the advance-notice is made, as described above, the CPU 54 causes the motor 38 to be placed in non-energization state through the interface 56, after which the coating operation is not effected unless the tank 10 is replenished with adhesive to prevent a so-called coating operation without adhesive and light the coating-termination lamp 66 to inform the user of the effect.

Of course, the user may, during the advance-notice, replenish the adhesive within the tank and may return it to the initial state by the operation of the key on the keyboard. That is, the user may replenish the adhesive during the time from the reception of the advance-notice to the stoppage of the coating operation. Alternatively, after the replenishment of the adhesive, the user may depress the selection key 62A to make the picture plane of the monitor TV 61 as shown in FIG. 9, operate the CLR key on the keyboard to clear each of set frequencies to reset the set data.

In such a coating apparatus, when any one of the leaving timers is timed up, both the small and large diameter coating nozzles become involved the leaving operation, and therefore there is an inconvenience in that even the nozzle which requires no leaving becomes involved leaving.

To cope with this, in case where the start key 63 is operated to re-start the coating operation, in case where the using nozzle is switched after one-side nozzle out of the large and small nozzles during the coating operation, and in case where the coating operation is restarted from the substrate portion marked with a bad mark to the substrate portion not marked with a bad mark, there is considered to make the processing possible for the case where any one of the leaving timers of the nozzles is timed up.

Such a structure will be described in conjunction with a flow chart of FIG. 13. In the case of the above-mentioned three conditions, the CPU 54 detects which timer out of the leaving timers 58, 58, 58 and 58 corresponding to the nozzles 6, 7, 8 and 9 times up (①) and sets, when it timed up, the nozzle to be left to the nozzle leaving memory region of the RAM 55 (②). More specifically, the nozzle leaving memory region is designed so that "0" and "1" are set corresponding to the nozzles 6, 7, 8 and 9 as shown in FIG. 14. For example, if the timers 58 and 58 of the nozzles 6 and 8 are timed up, "1" is set to the aforesaid region.

Next, the CPU discriminates whether the content of the leaving step counter 57 is more than the number of leaving steps (③), and if the content is more than the number of leaving steps, turns on the abnormal lamp 67 (④) to stop the coating operation. If the content of the leaving step counter 57 does not reach the number of leaving steps, the step of the address wherein the content of the leaving step counter 57 is added to the leading address M104 of the leaving step is selected (⑤). For example, if the content of the leaving step counter 57 is "2", the step of address M106 is selected.

Subsequently, the CPU discriminates whether the nozzle wherein the leaving timer 58 is timed up coincides with the nozzle selected by the nozzle selection data of the selected step (⑥). In the case where they are coincided, only for the leaving timed up nozzle, the leaving is carried out in the coordinate position assigned by the X-coordinate and Y-coordinate data (⑦), and the content of the leaving memory region within the RAM 55 is set to "0" (⑧). On the other hand, in the case where the timed up nozzle is not coincided with the nozzle selected by the nozzle selection data, the aforementioned operations (⑦) and (⑧) are jumped.

Thereafter, discrimination is made whether a control command of the selected leaving step is F (⑨). If it is not F, 1 is added to the content of the leaving step counter 57 (⑩), and discrination is made whether the content of the nozzle leaving memor "0" (⑪). If said content is 0, the step is returned to the coating operation (⑫), and if it is not "0", the step is returned to the step of (③). In case where in the step of (⑨), the control command is F, discrimination is made whether the content of the nozzle leaving memory is "0" (⑬), and if it is "0", the step is returned to the coating operation (⑫), whereas if it is not "0",

the abnormal lamp 67 is lighted ((4)) to stop the operation ((14)).

While in the above-described operation, the leaving positions are made to be separated according to the large or small nozzles, it is to be noted that for example, instead of the steps of ((5)) and ((7)), the leaving operation of the nozzle timed up in the selected position is carried out ((15)) despite the size (large or small) of the nozzle assigned by the nozzle selection data.

In such an apparatus, when the multiphase substrates 4 and 5 having the respective three substrate portions 4A, 4B and 4C; and 5A, 5B and 5C are likewise coated, reference is made to FIG. 15, in which the black circle indicates the point where the coating operation is effected, and the while circle indicates the point where the nozzle is moved to that position but the coating operation is not effected. In the adhesive coating operation for the substrate portions 4A, 4B, 4C, 5A, 5B and 5C, the small-diameter nozzles are first used and then switched to the large-diameter nozzles halfway of use. It is assumed that the substrate portions 5A and 5C have the bad marks M and M.

FIG. 16 is an enlarged view of a coating nozzle portion, FIG. 17 is a side sectional view of a nozzle tip, and FIG. 18 is a view of a nozzle tip as viewed from the lower surface thereof, which is the case of small-diameter nozzles for small parts used in the above-described first and third nozzles 6 and 8. Reference numeral 68 designates a substrate. This nozzle is formed with a plurality of adhesive supply channels 69A and 69B through which adhesive passes while being fed under pressure for a fixed period of time by high pressure air, and is formed with a communication groove 70 which brings openings at lower ends of the supply passages 69a and 69B into communication with each other, the groove having its lower surface opened.

Accordingly, when the adhesive is fed under pressure through the supply passage 69A and 69B, the adhesive is held on the tip of the coating nozzle 2 by surface tension and adhesion. The thus held adhesive is pressed in position between connection lands 71 and 71 on a wiring substrate 68 so that the former is transferred onto the substrate 68 to form an approximately 8-letter adhesive 72 as shown in FIG. 19. Therefore, an electronic part 73 has its opposite ends in the form of an electrode, as shown in FIG. 20, and the bottom surface of the part 73 and a part of the side thereof are adhered and held by the adhesive 72 so that the electrode may be positively coupled to the connection lands 71 and 71. That is, since the adhesive 72 is formed with circular portions 72A and 72B and a bridge portion 72C which bridges therebetween, the side of the electronic part 73 is adhered and held by the circular portions 72A and 72B of the adhesive 72, and the bottom surface of the part 73 is mainly adhered and held by the bridge portion 72c. Thus, the adhesive 72 is coated laterally lengthwise so that portions forced out of the opposite sides of the electronic part 73 are continuously connected, and adhered and held in a well balanced stable condition. The adhesive 72 used is of the ultraviolet or thermosetting, and it can be set before application of soldering.

Next, the large-diameter nozzle used in the aforesaid second and fourth nozzles 7 and 9 will be described with reference to FIGS. 6 and 7. A prismatic coating nozzle 12 is formed with adhesive supply passages 74A and 74B having a circular section, which are in turn formed at their tips with a communication groove 75 which is narrower than the diameter of the passages 74A and 74B. This prevents generally oval shaped adhesive from being coated on the wiring substrate 68 in the case where when the diameter of the supply passages 74A and 74B increases, the width of the communication groove likewise increases. If such an oval shape is employed, when the electronic part 73 is placed on the adhesive, the adhesive is spread, and the adhesive is stuck to the connection lands 71 and 71, which obstructs soldering effected later. The above-described arrangement prevents occurrence of such a situation.

An auxiliary supply channel 76, which is smaller in diameter than that of the supply channels 74A and 74B and has about the same dimension as the width of the communication groove 75 can be formed in the intermediate position of the communication groove 75 whereby positively preventing the occurrence of the situation not to form the bridge portion 72C of the adhesive 72 generated if the width of the communication groove 75 is excessively narrow.

While in the above-described embodiment of the present invention, the leaving portions of the coating nozzles 6, 7, 8 and 9 were marginal portions 4D and 5D of the printed substrates 4 and 5, it is to be noted that the leaving can be made at suitable locations other than the printed substates 4 and 5.

Claims

(1) A method of coating adhesive for mounting parts onto a printed substrate characterized in that a plurality of adhesive coating nozzles are arranged in correspondence to a plurality of the printed substrates placed on an X-Y table controlled to be moved in an X-Y direction at fixed intervals, and each of these coating nozzles are selectively synchronized to coat the adhesive within an adhesive storage tank in position on each of the printed

substrates, at which a waste coating is carried out for each of said coating nozzles before the latter perform the coating operation with respect to the printed substrate.

(2) A method of coating adhesive for mounting parts onto a printed substrate according to Claim 1, wherein said coating nozzles are left on marginal portions on the printed substrates.

(3) A method of coating adhesive for mounting parts onto a printed substrate according to Claim 1, wherein said coating nozzles are left on suitable places other than the printed substrates.

(4) An apparatus for coating adhesive for mounting parts onto a printed substrate wherein a plurality of adhesive coating nozzles are arranged in correspondence to a plurality of multiphase printed substrates placed on an X-Y table controlled to be moved in an X-Y direction at fixed intervals, and each of these coating nozzles are selectively synchronized to coat the adhesive within an adhesive storage tank in position on each of the printed substrates, said apparatus comprising counter means provided in correspondence to said coating nozzles, respectively, to count unused time, and control means for driving and controlling said coating nozzles and said X-Y table so as to effect leaving operation before effecting coating operation by said coating nozzles onto the printed substrates at the timing of passage of time-up time by said counter means.

(5) An apparatus for coating adhesive for mounting parts onto a printed substrate according to Claim 4, wherein a plurality of adhesive supply channels are provided in said coating nozzles, said supply channels being communicated with each other at head ends through a communication groove.

(6) An apparatus for coating adhesive for mounting parts onto a printed substrate according to Claim 4 or 5, wherein an advance-notice sensor which detects that the residual of the adhesive has reduced to a predetermined amount, and informing means which effect informing according to detection by said advance-notice sensor are provided on said coating nozzles.

(7) An apparatus for coating adhesive for mounting parts onto a printed substrate according to Claim 4, 5 or 6, wherein a coating nozzle is arranged in correspondence to the printed substrate placed on an X-Y table controlled to be moved in an X-Y direction and said coating nozzle is operated to coat the adhesive within an adhesive storage tank in position on the printed substrate, said apparatus comprising counter means provided in correspondence to said coating nozzle, respectively, to count unused time, and control means for driving and controlling said coating nozzle and said X-Y table so as to effect waste coating before effecting coating operation by said coating nozzle onto the printed substrate at the timing of passage of time-up tim by said counter means.

(8) An apparatus for coating adhesive for mounting parts onto a printed substrate according to Claim 4, 5 or 6, wherein a plurality of adhesive coating nozzles are arranged in correspond nce to the printed substrate placed on an X-Y table controlled to be moved in an X-Y direction, and each of these coating nozzles are selectively synchronized to coat the adhesive within an adhesive storage tank in position on the printed substrate, said apparatus comprising counter means provided in correspondence to said coating nozzles, respectively, to count unused time, and control means for driving and controlling said coating nozzles and X-Y table so as to effect waste coating before effecting coating operation by said coating nozzles onto the printed substrate at the timing of passage of time-up time by said counter means.

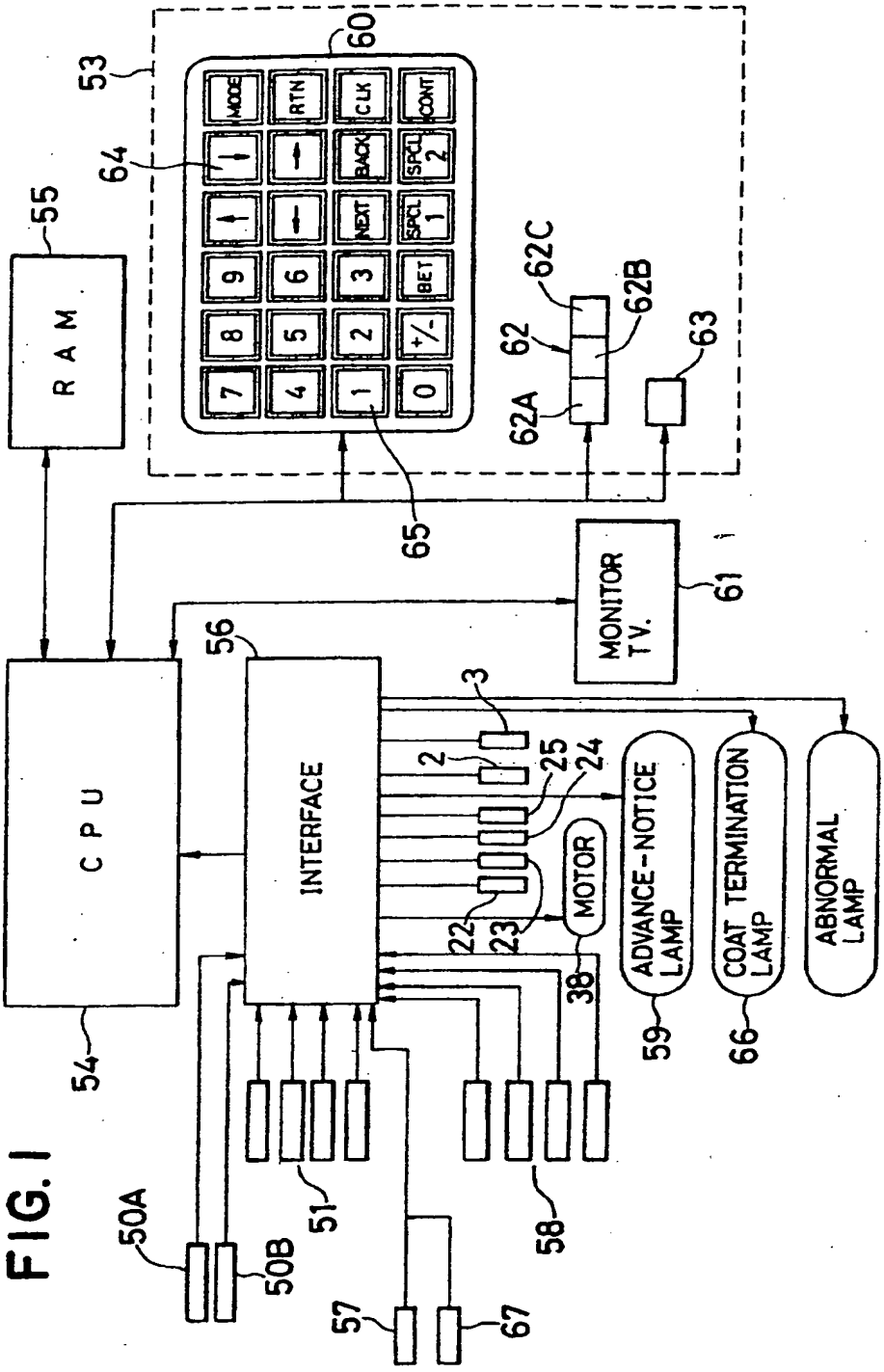

53
60
MODE
RTN
CLK
CONT
64
BACK
SPCL 2
NEXT
SPCL 1
9
6
3
BET
8
5
2
+/-
7
4
1
0
55
RAM
62C
62B
62
63
62A
65
MONITOR T.V.
61
56
CPU
INTERFACE
3
2
25
24
22
23
MOTOR
38
ADVANCE-NOTICE LAMP
COAT TERMINATION LAMP
ABNORMAL LAMP
59
66
54
50A
50B
51
58
57
67

FIG. 1

FIG. 2

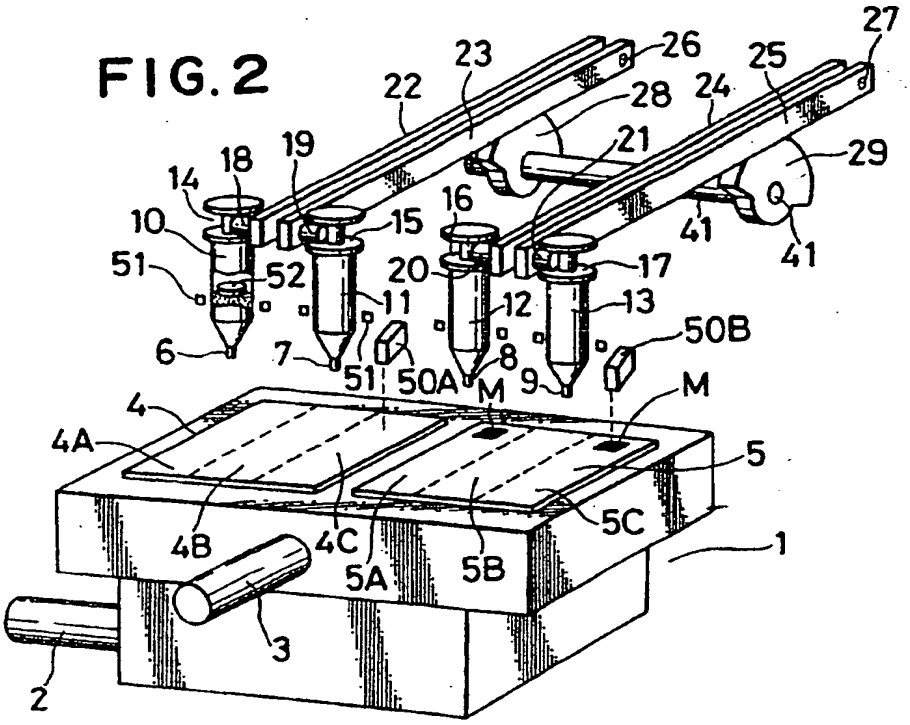
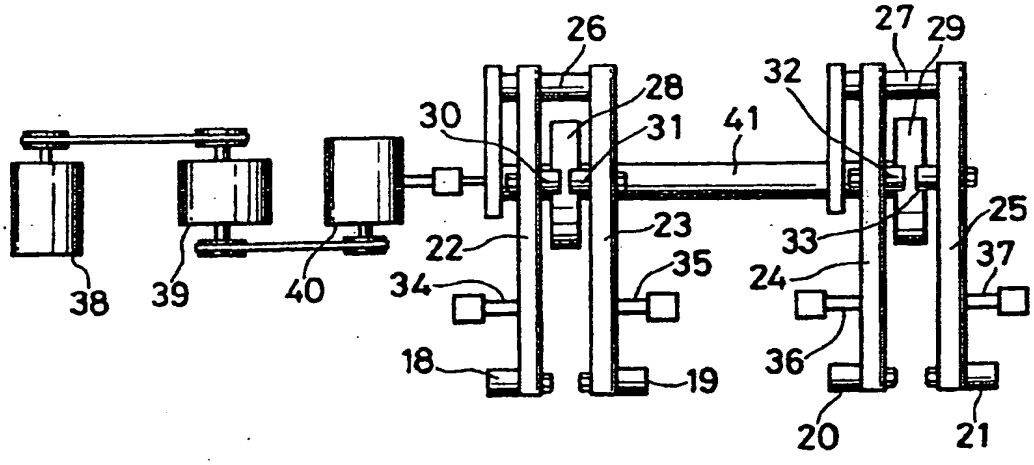

27
26
25
23
22
28
24
21
29
19
18
14
16
15
10
41
41
51
52
20
17
11
12
13
50B
6
7
51
50A
M
8
9
M
4
4A
5
5C
4B
4C
5A
5B
1
3
2

FIG. 3


26
27
29
28
32
30
31
41
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33
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37
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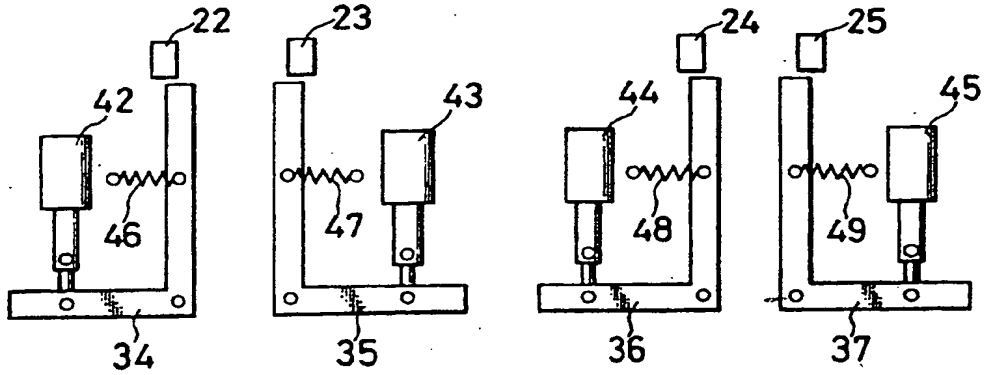
34
38
39
40
36
18
19
20
21

FIG.4


22
23
24
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42
43
44
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46
47
48
49
34
35
36
37

FIG.5

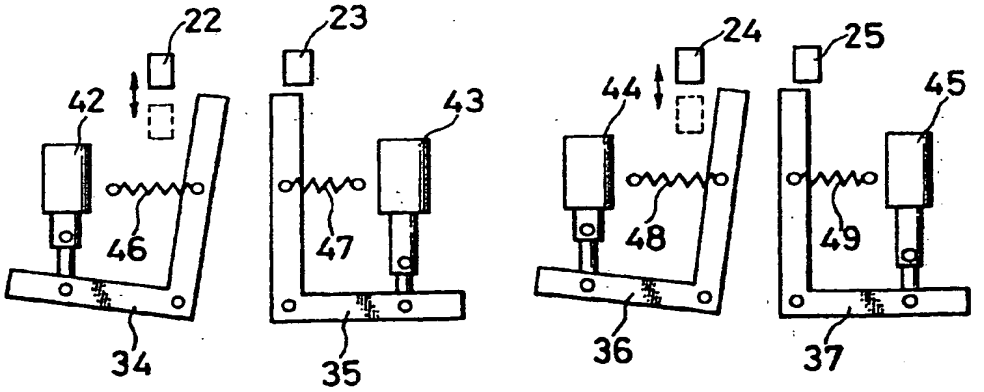

22
23
24
25
42
43
44
45
46
47
48
49
34
35
36
37

FIG.6

STEP	X-COORDINATE DATA	Y-COORDINATE DATA	ANGLE DATA	NOZZLE SELECT DATA	CONTROL COMMAND	
M 1	x_1	y_1	z_1	0		COATING DATA
M 2	x_2	y_2	z_2	0		
M 3	x_3	y_3	z_3	1		
⋮	⋮	⋮	⋮	⋮		
M 100	x_{100}	y_{100}	z_{100}	0	P	
M 101	0	0	0	—		REPEATED PATTERN DATA
M 102	x_1	0	0	—		
M 103	x_2	0	0	—	E	
M 104	x_3	y_4	0	0		LEAVING DATA
M 105	x_4	y_5	0	1		
M 106	x_5	y_6	0	0		
M 107	x_6	y_7	0	1		
M 108	x_7	y_8	0	0		
M 109	x_8	y_9	0	1		
M 110	x_9	y_{10}	0	0		
M 111	x_{10}	y_{11}	0	1	F	

0 278 457

FIG. 7

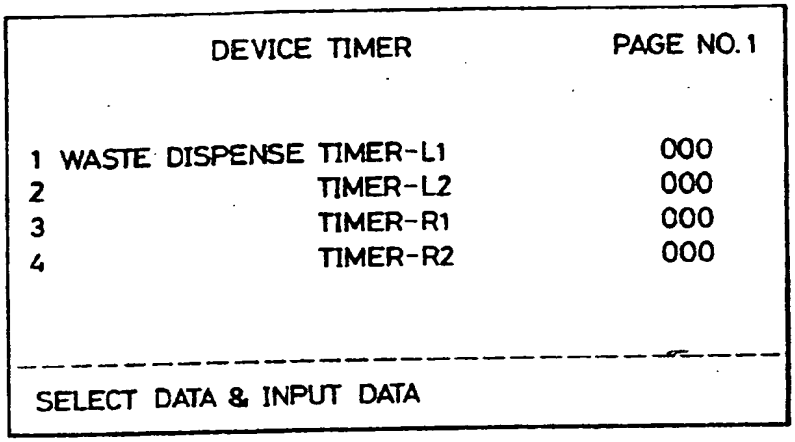

DEVICE TIMER
PAGE NO. 1
1 WASTE DISPENSE TIMER-L1 000
2 TIMER-L2 000
3 TIMER-R1 000
4 TIMER-R2 000
SELECT DATA & INPUT DATA

FIG. 8

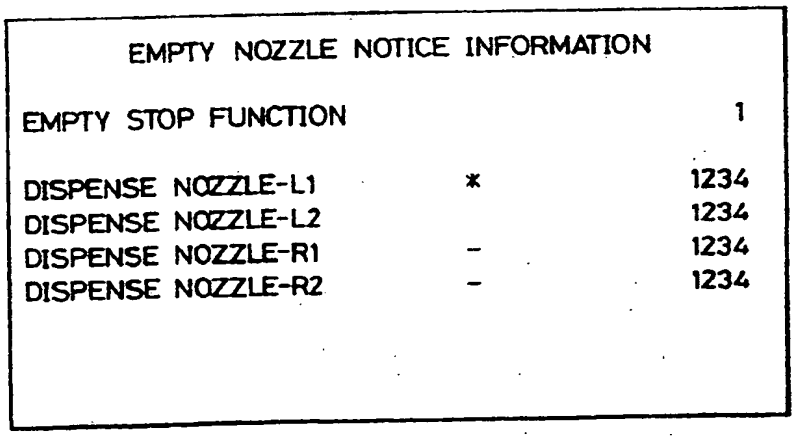
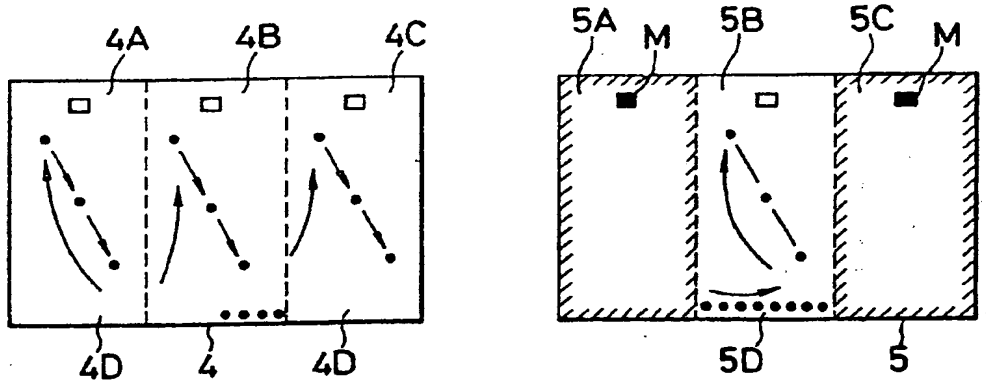

EMPTY NOZZLE NOTICE INFORMATION
EMPTY STOP FUNCTION 1
DISPENSE NOZZLE-L1 * 1234
DISPENSE NOZZLE-L2 1234
DISPENSE NOZZLE-R1 - 1234
DISPENSE NOZZLE-R2 - 1234

FIG. 9

EMPTY STOP DATA	
EMPTY STOP FUNCTION	0
UNTIL EMPTY TIMES L1	1234
UNTIL EMPTY TIMES L2	1234
UNTIL EMPTY TIMES R1	1234
UNTIL EMPTY TIMES R2	1234

FIG. 11



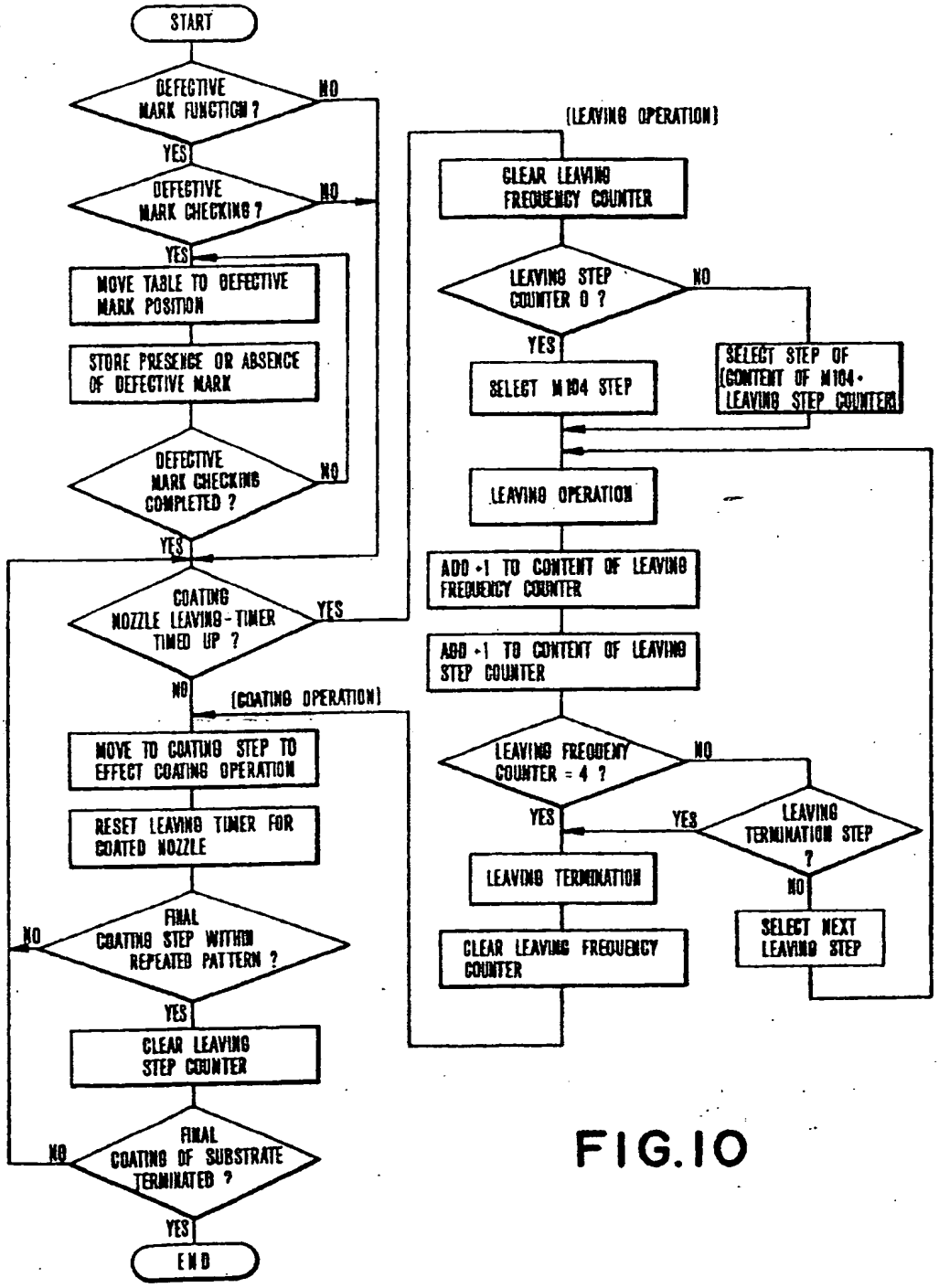

START
DEFECTIVE MARK FUNCTION ?
NO
YES
DEFECTIVE MARK CHECKING ?
NO
YES
MOVE TABLE TO DEFECTIVE MARK POSITION
STORE PRESENCE OR ABSENCE OF DEFECTIVE MARK
DEFECTIVE MARK CHECKING COMPLETED ?
NO
YES
COATING NOZZLE LEAVING-TIMER TIMED UP ?
YES
NO
(COATING OPERATION)
MOVE TO COATING STEP TO EFFECT COATING OPERATION
RESET LEAVING TIMER FOR COATED NOZZLE
FINAL COATING STEP WITHIN REPEATED PATTERN ?
NO
YES
CLEAR LEAVING STEP COUNTER
FINAL COATING OF SUBSTRATE TERMINATED ?
NO
YES
END
(LEAVING OPERATION)
CLEAR LEAVING FREQUENCY COUNTER
LEAVING STEP COUNTER 0 ?
NO
YES
SELECT M104 STEP
SELECT STEP OF (CONTENT OF M104 + LEAVING STEP COUNTER)
LEAVING OPERATION
ADD +1 TO CONTENT OF LEAVING FREQUENCY COUNTER
ADD +1 TO CONTENT OF LEAVING STEP COUNTER
LEAVING FREQUENY COUNTER = 4 ?
NO
YES
YES
LEAVING TERMINATION STEP ?
NO
LEAVING TERMINATION
CLEAR LEAVING FREQUENCY COUNTER
SELECT NEXT LEAVING STEP

FIG.10

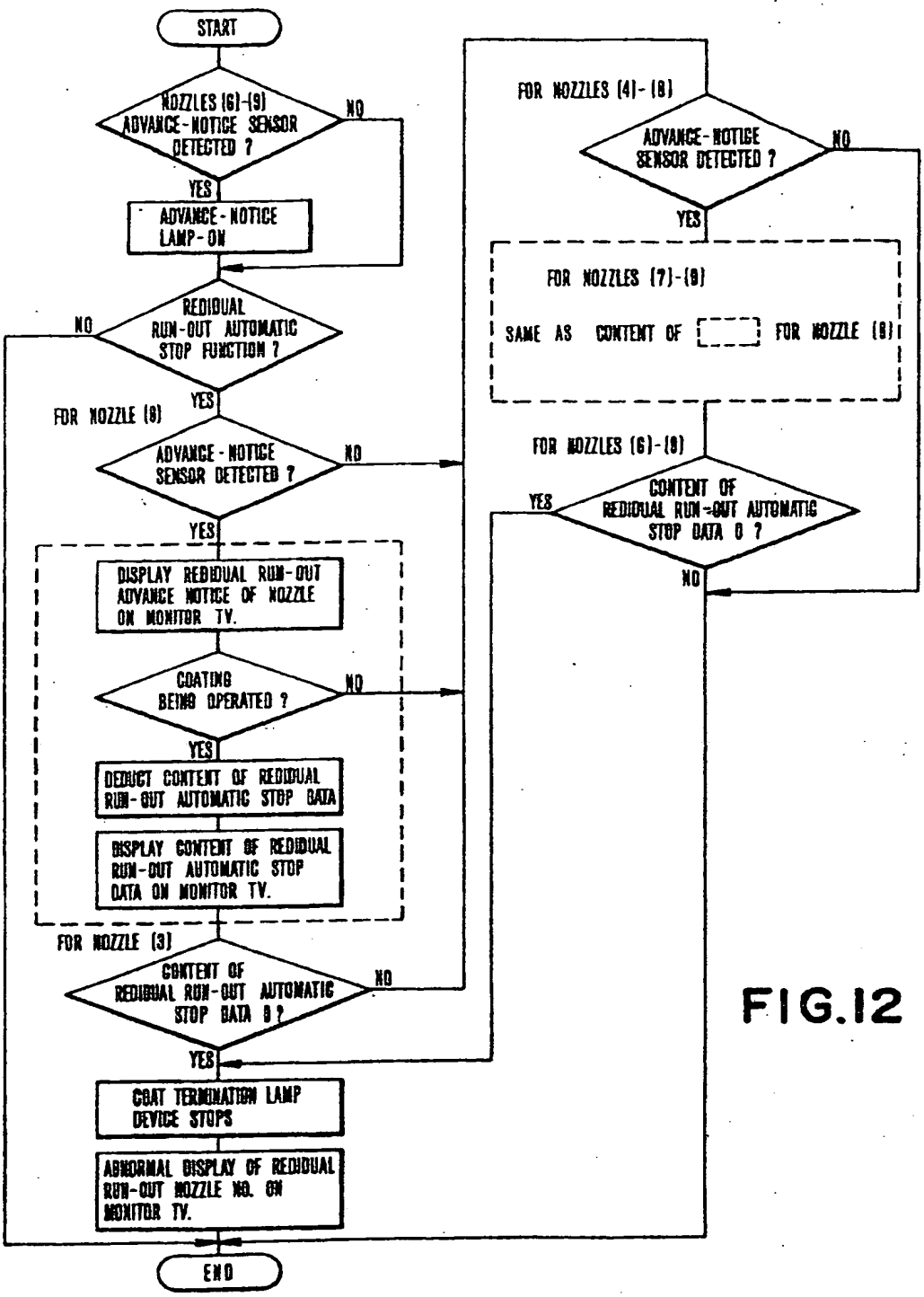

START
NOZZLES (6)-(9) ADVANCE-NOTICE SENSOR DETECTED ?
NO
YES
ADVANCE-NOTICE LAMP-ON
REDIDUAL RUN-OUT AUTOMATIC STOP FUNCTION ?
NO
YES
FOR NOZZLE (8)
ADVANCE-NOTICE SENSOR DETECTED ?
NO
YES
DISPLAY REDIDUAL RUN-OUT ADVANCE NOTICE OF NOZZLE ON MONITOR TV.
COATING BEING OPERATED ?
NO
YES
DEDUCT CONTENT OF REDIDUAL RUN-OUT AUTOMATIC STOP DATA
DISPLAY CONTENT OF REDIDUAL RUN-OUT AUTOMATIC STOP DATA ON MONITOR TV.
FOR NOZZLE (3)
CONTENT OF REDIDUAL RUN-OUT AUTOMATIC STOP DATA 0 ?
NO
YES
COAT TERMINATION LAMP DEVICE STOPS
ABNORMAL DISPLAY OF REDIDUAL RUN-OUT NOZZLE NO. ON MONITOR TV.
END
FOR NOZZLES (4)-(8)
ADVANCE-NOTICE SENSOR DETECTED ?
NO
YES
FOR NOZZLES (7)-(9)
SAME AS CONTENT OF [ ] FOR NOZZLE (8)
FOR NOZZLES (6)-(8)
CONTENT OF REDIDUAL RUN-OUT AUTOMATIC STOP DATA 0 ?
YES
NO

FIG.12

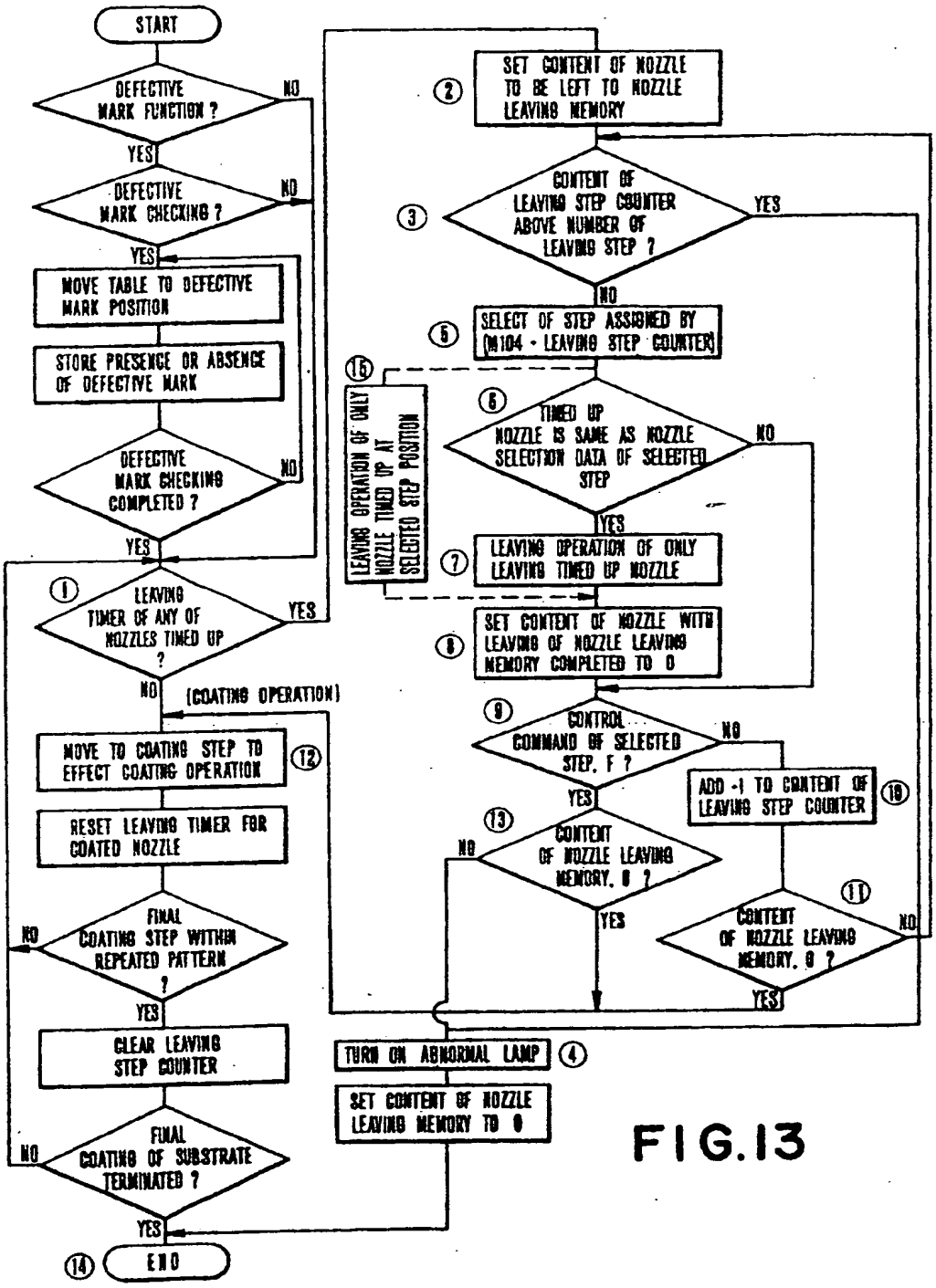
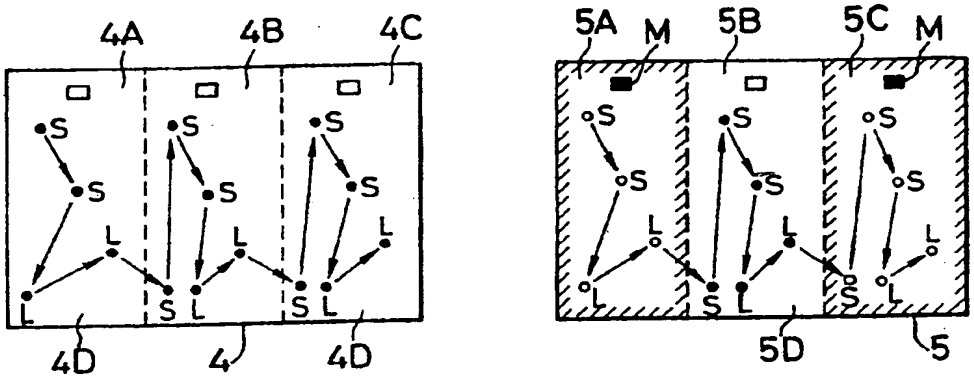

START
DEFECTIVE MARK FUNCTION ?
NO
YES
DEFECTIVE MARK CHECKING ?
NO
YES
MOVE TABLE TO DEFECTIVE MARK POSITION
STORE PRESENCE OR ABSENCE OF DEFECTIVE MARK
DEFECTIVE MARK CHECKING COMPLETED ?
NO
YES
1
LEAVING TIMER OF ANY OF NOZZLES TIMED UP ?
YES
NO
(COATING OPERATION)
MOVE TO COATING STEP TO EFFECT COATING OPERATION
12
RESET LEAVING TIMER FOR COATED NOZZLE
FINAL COATING STEP WITHIN REPEATED PATTERN ?
NO
YES
CLEAR LEAVING STEP COUNTER
FINAL COATING OF SUBSTRATE TERMINATED ?
NO
YES
14
END
2
SET CONTENT OF NOZZLE TO BE LEFT TO NOZZLE LEAVING MEMORY
3
CONTENT OF LEAVING STEP COUNTER ABOVE NUMBER OF LEAVING STEP ?
YES
NO
5
SELECT OF STEP ASSIGNED BY (M104 - LEAVING STEP COUNTER)
15
LEAVING OPERATION OF ONLY NOZZLE TIMED UP AT SELECTED STEP POSITION
6
TIMED UP NOZZLE IS SAME AS NOZZLE SELECTION DATA OF SELECTED STEP
NO
YES
7
LEAVING OPERATION OF ONLY LEAVING TIMED UP NOZZLE
8
SET CONTENT OF NOZZLE WITH LEAVING OF NOZZLE LEAVING MEMORY COMPLETED TO 0
9
CONTROL COMMAND OF SELECTED STEP, F ?
NO
YES
18
ADD -1 TO CONTENT OF LEAVING STEP COUNTER
13
CONTENT OF NOZZLE LEAVING MEMORY, 0 ?
NO
YES
11
CONTENT OF NOZZLE LEAVING MEMORY, 0 ?
NO
YES
TURN ON ABNORMAL LAMP
4
SET CONTENT OF NOZZLE LEAVING MEMORY TO 0

FIG.13

FIG.14

NOZZLE	(6)	(7)	(8)	(9)
	1	0	1	0

FIG.15



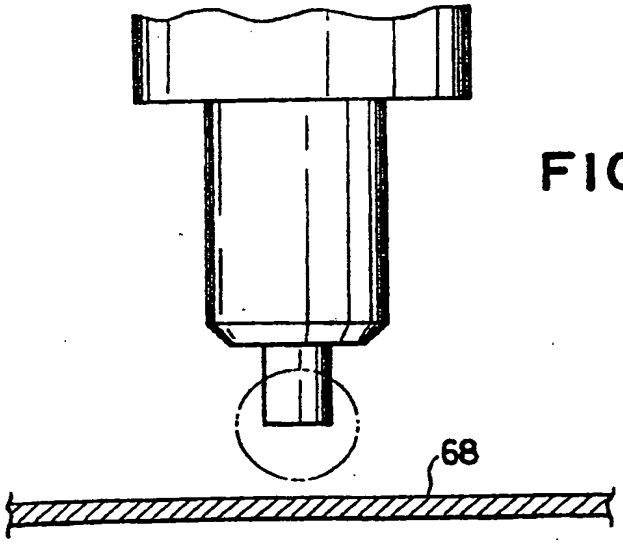


FIG.16

FIG.17

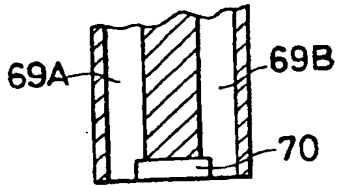


FIG.18

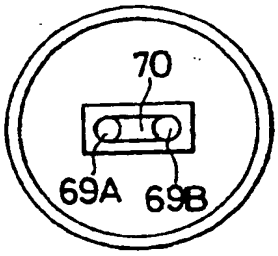


FIG.19

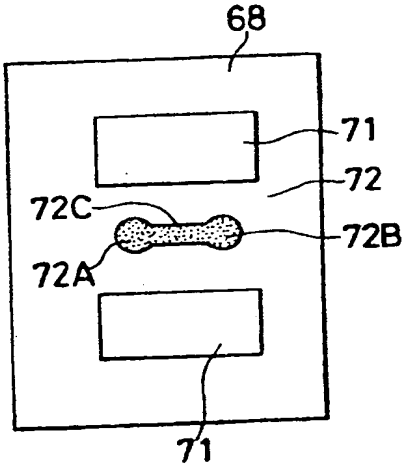


FIG.20

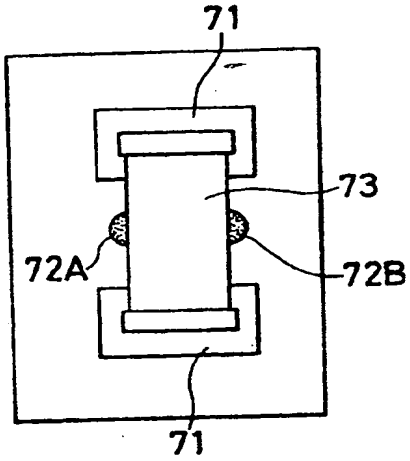


FIG.21

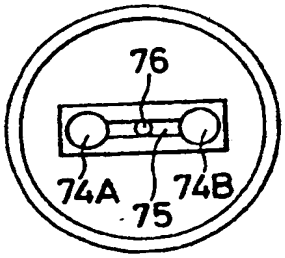


FIG.22